Cloudy skies may help forecast global climate change

Sandia joins other atmospheric researchers in Oklahoma to gather radiation modeling data

By Nancy Garcia

California Reporter

Scores of researchers and support staff who gathered in Oklahoma in October were hoping they would encounter some bad weather.

These folks were assembled to measure how clouds soak up or reflect energy from the sun — data that should help improve computer models that predict global climate change. Clouds present a big uncertainty to these modeling efforts.

"Cloudy skies are so complicated, we don't have an accurate understanding of what really happens," says John Vitko of Sandia's Global Climate Change/Remote Sensing Office 8102 and director of the Atmospheric Radiation Measurement Enhanced Shortwave Experiment.

Clouds and sunlight

In the experiment, two planes fly like slices of bread in a "cloud sandwich," with a layer of smooth cloud between, measuring the sun's energy on both sides of the clouds stretched over Oklahoma and south-central Kansas.

Sunlight hitting the clouds may be absorbed significantly more than predicted by current climate models. This is important because these models are used to predict our climate and to understand how the earth may

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CLOUDS AND CLIMATE — John Vitko of Global Climate Change/Remote Sensing Office 8102 is interviewed by an Oklahoma TV reporter in front of the high-altitude Egrett aircraft at the Blackwell-Tonkawa Airport. John is director of the Atmospheric Radiation Measurement Enhanced Shortwave Experiment, making radiometer measurements of energy above and below clouds in Oklahoma and south-central Kansas. Forty Sandians are involved. (Photo by Dick Jones)

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Clouds

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be responding to increasing levels of greenhouse gases such as carbon dioxide. The Oklahoma experiments should shed more light on this phenomenon.

Flying in a stacked formation, a high-altitude Egrett aircraft and a more conventional Twin Otter were each outfitted to spend 75 hours collecting data about the visible and infrared light absorbed, reflected, or transmitted through the cloud layer.

The Egrett maintains an altitude of approximately 13,100 meters (43,000 feet) as it collects data and transmits it to the payload ground station. There, the data are translated to a common data format, recorded on digital tape, and sent to the project scientists for immediate analysis. The Egrett was originally constructed for the German government as a high-altitude reconnaissance plane.

The Twin Otter, often used to transport people and freight in remote areas, flies under the cloud formation and parallel with the Egrett at about 450 meters (1,500 feet). The Otter collects the same kind of data as the Egrett but stores it digitally until it can be fed into the main computer banks the following day.

Each plane carries 144 kilograms (300 pounds) of instrumentation, primarily six radiometers, to measure the radiant energy from the sun and earth. Scientists are concentrating on energy passing through the atmosphere between 450 and 15,200 meters (1,500 and 50,000 feet) — data that cannot be collected from ground-based instruments.

Although they are not flying in parallel with the Egrett and Otter, several other platforms will provide data at key altitudes. Satellites will provide top-of-the-atmosphere data. An ER-2 high-altitude research plane, owned by NASA, will provide data at 19,800 meters (65,000 feet), and DOE's Cloud and Radiation Testbed will provide surface data.

Global circulation models

By analyzing these data and comparing the various data sets, scientists can get a better understanding of the role of clouds in warming or cooling the earth. "Scientists will use this new understanding to improve the general parameters that global circulation models use," says Francisco P.J. Valero of the Scripps Institution of Oceanography, chief scientist for the Atmospheric Radiation Measurement Enhanced Shortwave Experiment. "We think we can help people sharpen their predictions."

A previous series of flight experiments in April 1994 collected data from clear skies.

The experiment is part of the research conducted by DOE's Atmospheric Radiation Measurement Program and the associated Unmanned Aerospace Vehicle Program. These experimental and modeling programs are designed to improve how large-scale computer models, used to predict climate change, treat cloud and atmospheric radiative processes. Funding for the programs comes from DOE and the Department of Defense Strategic Environmental Research and Development Program.

Sandia plays a major role in this multiagency, multilaboratory experiment. In addition to providing overall technical direction, Sandia is responsible for payload and aircraft integration, real-time telemetry of data, data management, development of a compact cloud radiometer, and actual conduct of operation. This involves some 40 Sandians from across some 15 departments (2663, 5354, 5361, 5364, 5371, 5725, 8102, 8115, 8230, 8272, 8351, 8411, 8413, 8416, and 8417), all working in a closely knit team.

In addition, team members came from four other DOE laboratories, three NASA centers, a half dozen universities, and three aircraft companies. "Approximately 30 to 40 researchers, pilots, and support staff worked to get the airborne data collection off the ground," says Deputy Technical Director Will Bolton of Dept. 8102, "with some 120 people sharing responsibility for the project in rotating shifts. The cooperation between the different agencies and laboratories has been absolutely fantastic."